FAA E 2290c
December 4, 1979
Amendment 1

# DEPARTMENT OF TRANSPORTATION
## FEDERAL AVIATION ADMINISTRATION
## SPECIFICATION

CONTROL EQUIPMENT, RADIO CHANNEL

This amendment forms a part of FAA-E-2290c dated January 20, 1975.

Page 3, paragraph 3.2.1.1: In line 3, change "50-60 Hz." to "60 Hz.".

Page 3, paragraph 3.2.2.1: Delete.

Page 3, add the following paragraph: "3.2.7 Emergency Module. - The term "emergency" module as used herein shall denote the special mechanical requirements for the selector switches on the front panel of the individual plug-in modules used in the ATCT (Type I) and FSS (Type II) Selector Units. With the exception of the special requirements for the switches, all modules of each specific type shall be mechanically and electrically interchangeable."

Page 4, paragraph 3.3.1.1. - Add the following: "Another control shall be provided on the printed circuit card of the module in the audio unit to adjust the speaker audio output level over a range of 10 dB."

Page 4, paragraph 3.3.1.2. - Add the following: "Another control shall be provided on the printed circuit card of the module in the audio unit to adjust the headset audio output level over a range of 10 dB."

Page 4, paragraph 3.3.2. - Add the following: "The switch handle on the transmitter and receiver selector switches on the front panel for emergency selector modules shall be red in color. A level control with a 20 dB adjustment range shall be provided on the printed circuit card at the input of each selector module to adjust equipment for operation with received input signal levels that way vary between channels."

Page 5, paragraph 3.3.2.1.1: Delete the last sentenc
"For emergency selector modules, the transmitter
Type 12TW1-5N, or equal, that is manufactured
is also a three-position switch. The center pos
in the down position for momentary selection
OFF. To select for continuous use, the swi
on a smooth cam and then place the switc

Page 6, paragraph 3.3.2.2: Delete the
therefore: "For emergency selector module
have an extra locking feature in the form of a
the switch can be locked in any of the three posi

Page 6, paragraph 3.3.3. - Add the following: "The switc
receiver and muting selector switches on the front panel of
modules shall be red in color. A level control shall be provided
circuit card at the input of each selector module to adjust equipment
for receive signals that vary up to 20 dB."

Page 7, paragraph 3.3.3.1: Change "from 6 to 30 dB" to "from 6 to at least 50 dB" (two places in the paragraph). Delete the last sentence and substitute the following: "For emergency selector modules, the mute switch shall have an extra locking feature in the form of a "pull-to-unlock" design so that the switch can be locked in any of the three positions."

Page 7, paragraph 3.3.3.1.1. - In line 6 change "30 dB" to "at least 50 dB."

Page 7, paragraph 3.3.3.2. - Change the second sentence to read: "The volume control shall permit adjustment of at least 12 dB of the audio level for the headset and loudspeaker output."

Page 7, paragraph 3.3.4: Delete the text and substitute: "The jack unit shall permit connection of the controller (CONTR) headset or the instructor (INSTR) headset (external equipments not covered by this specification) to the audio unit at a location remote (up to eight feet) from the position audio unit."

Page 8, paragraph 3.4.1.2: Add the following: "The tape recorder connector shall also contain terminals for external input to the speaker system for operation with Option X (3.6.4.10)."

Page 8, paragraph 3.4.1.3: In line 4, change "the" to "both". Add the following: "The telephone system connector shall also contain terminals for external input to the speaker system for operation with Option X (3.6.4.10)."

Page 9, paragraph 3.4.1.5. In line 4, delete the words "low level".

Page 9, paragraph 3.4.2.3: Delete line 3 and substitute: "...additional conductors, which may require to be shielded based on the contractor's design. This total provides a shielded transmitter...". Add the following: "Shielding of other intra-position or inter-position circuits of the equipment in order to meet performance requirements shall be determined by the contractor."

Page 9, paragraph 3.4.3: Delete the first sentence and substitute: "The jack unit shall contain two (2) headset jacks (3.4.3.2) and a multi-conductor cable at least eight feet in length."

Page 10, paragraph 3.4.3.1: Delete.

Page 10, paragraph 3.4.3.2: Delete and substitute: "Two (2) headset jacks, each suitable for mating with a JAN-type PJ-511 plug, shall be mounted on the jack unit front panel."

Page 10, paragraph 3.4.6: Delete and substitue the following: "Each equipment furnished by the contractor shall be complete in accordance with all specification requirements. The equipment modules and units furnished shall be mechanically and electrically interchangeable with like items that have been furnished by the contractor to the Government."

Page 11, paragraph 3.5.2: In line 5 delete "11 inches." and substitute "13 inches to the extremity of any installed mating connector and its associated cable on the rear of the selector chassis."

Page 11, paragraph 3.5.3: Delete the second sentence and substitute: "Two (2) each headset jacks shall be mounted on the front panel."

Page 11, paragraph 3.5.4: In line 4, change "12" to "13 3/8" inches.

Page 12, paragraph 3.6: Delete line 6 and substitute: "...be each headset input which shall be terminated in a 50 ohm ±1% resistor.". Add the following: "Unless otherwise specified, all performance requirements are with the transmit regulator switch in its ON position."

Page 12, paragraph 3.6.1.1: Add the following: "The single exception to the 3dB response stated above is with the Option X audio path. With option X implemented, the frequency response over the range of 300 to 3000 Hz shall be within ± 3.5 dB of the 1000 Hz level."

Page 12, paragraph 3.6.1.2: Delete and substitute: "Total harmonic distortion of transmit audio circuits over the range of 300 to 3000 Hz shall not exceed 8 percent with an input signal level of -11dBm at the headset jack. Total harmonic distortion of headset and speaker audio circuits shall not exceed 2 percent and 5 percent respectively, over the range of 300 to 3000 Hz for an input signal level between -40 dBm and -15 dBm."

Page 13, paragraph 3.6.1.3: Delete last sentence and substitute: "The input test levels shall be -11 dBm applied to each headset jack (one at a time) and -20 dBm at all other inputs."

Page 13, paragraph 3.6.1.4: In lines 4, 6, and 8, change "-40 dBm" to "-65 dBm". In line 8, change "-35 dBm" to "-45 dBm".

Page 13, paragraph 3.6.2.1: Delete line 3 and substitute: "controller headset jack, instructor headset jack, or auxiliary telephone connector."

Page 13, paragraph 3.6.2.1.1: Delete and substitute: "The jack unit shall control the path for three transmit audio lines: telephone and two headset circuits. When keying any one of the three inputs, only that input which is keyed shall transmit audio to the transmit amplifier. Under these conditions, the two inputs that are unkeyed shall each be isolated a minimum of 50 dB from the transmit path. The order of keying priority are INSTR headset first, auxiliary telephone second, and CONTR headset third. The higher priority keying circuit shall have the capability to override the lower priority keying circuit. When none of the three inputs are keyed, only the CONTR headset jack shall have an audio path to the transmit amplifier. Three (3) each screwdriver type of level controls shall be provided in the jack unit. One control shall provide up to 10 dB attenuation in each headset output level; this attenuation will be used to equalize the headset output level to compensate for signal loss in external interface circuitry of the telephone receive channel. The third control shall be provided to adjust for system operation with transmit input signals at the position telephone connector (3.4.1.3) that can vary over the range of -30 dBm to -15 dBm."

Page 13, paragraph 3.6.2.2: Delete the first sentence.

Page 14, paragraph 3.6.2.4: Delete and substitute: "When a 1000 Hz, -11 dBm signal is applied to either headset jack, and the output level control is fully clockwise, the signal level at the appropriate selector unit radio equipment connector for any selected channel shall be between -5 dBm and 0 dBm. The difference in output level between any two selected channels at a position shall not be more than 2 dB. Additionally, when a 1000 Hz, -30 dBm signal is applied to the auxiliary telephone microphone connector and when a 1000 Hz, -11 dBm signal is applied to either headset jack input, any of these audio paths, when keyed shall result in an output level between -5 dBm and 0 dBm.

Page 14, paragraph 3.6.2.5. - Add the following: "Active solid-state devices shall not be connected to the transformer secondary."

Page 14, paragraph 3.6.2.7: In line 1, change "-55" to "-11" dBm. In line 4, change "-35" to "+9" dBm.

Page 14, paragraph 3.6.2.7.1: Delete and substitute: "With an input signal of 1000 Hz at -11 dBm applied to either headset jack, and with the output level control set for maximum output, the range of adjustment of the regulator control shall be such that regulation starts at all values within the range of -5 dBm to 0 dBm as measured at the output of the selected channel. The regulator control shall provide sufficient range of adjustment that with an input signal of -10 dBm at the telephone connector or +9 dBm at either headset jack, the output shall be of at least +10 dBm with the regulation switch ON. The -11 dBm and +9 dBm requirements are based on steady state input signal levels which are 20 dB above the levels specified in 3.6.2.4."

Page 15, paragraph 3.6.2.8: Delete lines 1 and 2 and substitute: "When a steady-state 1000 Hz, -11 dBm input applied to either headset jack is suddenly raised to +9 dBm the output level shall be within $\pm$ 1.5 dB...."

Page 15, paragraph 3.6.2.9: Delete lines 1 and 2 and substitute: "When a steady-state 1000 Hz, +9 dBm input applied to each headset jack (one at a time) is suddenly decreased to -11 dBm, the output level shall..."

Page 15, paragraph 3.6.2.10: In line 3, change "-55" and "the microphone" to "-11" and "applied to each headset jack (one at a time)", respectively. In line 5, change "the headset jack" to "either headset jack". Add the following: "The sidetone signals shall not be mixed in the recorder output (3.6.5)."

Page 15, paragraph 3.6.2.11. - Change "3 dB" to "4 dB".

Page 15, paragraph 3.6.2.12: Delete lines 1 and 2 and substitute: "With a 1000 Hz signal at +9 dBm applied to each headset jack (one at a time), and one or more transmitter channels keyed,..."

Page 16, paragraph 3.6.3.3: Delete and substitute: "Each selector module shall be provided a set of form A dry keying contacts rated at 50 volt-amperes, 1 ampere minimum into a resistive load. Contact life at rated current shall be at least 10 million operations before contact resistance exceeds 0.1 ohm. The keying contacts shall not be position sensitive."

Page 16, paragraph 3.6.4.1. - Add the following: "Active solid-state devices shall not be connected to the transformer primary."

Page 16, paragraph 3.6.4.2: Delete and substitute: "Input impedance of each receiver channel shall be designed to operate with external circuits having a nominal impedance of 600 ohms, resistive. In meeting this requirement, the headset or speaker output level shall not vary by more then 1 dB when the system configuration is varied from one (1) position to twelve (12) positions and each position shares (parallels) the same receiver audio input circuit that is connected to all positions having the same frequency."

Page 17, paragraph 3.6.4.5: Delete the text in its entirety and substitute: "A headset amplifier shall be located in the audio unit. With the headset level control (3.3.1.2) set for maximum output and a receiver selector switch in the headset position, a -28 dBm tone within the frequency range of 300 to 3000 Hz applied to the input of any selector unit of the position shall result in an output of at least -5 dBm at either headset jack and the telephone connector. With the headset volume control (3.3.1.2) set maximum counterclockwise, and under the same above conditions, the minimum output signal at either headset jack (measured at a time) shall be -25 dBm ±3 dB. By selection of a strap option, all these requirements shall also be met with a -20 dBm input level."

Page 17, paragraphs 3.6.4.5.1 through 3.6.4.5.4: Delete these subparagraphs and substitute:

"3.6.4.5.1 Parallel headset operation. - Dependent on the setting of the strap options (3.6.4.5, 3.6.4.6), apply a -20 dBm or -28 dBm signal to the appropriate selector unit module wit the CONTR headset jack terminated in 600 ohms and the auxillary telephone and INSTR output circuits unterminated. Adjust the headset volume control for -5 dBm output. Terminate the INSTR headset output in 600 ohms; the headset output for both the INSTR and CONTR shall be -8.5 dBm ±1 dB."

Page 18, paragraph 3.6.4.6: Delete and substitute: "A loudspeaker amplifier shall be located n the audio unit. With the loudspeaker volume control (3.3.1.1) set fully clockwise and any receiver selector switch in the "loudspeaker" position, a -28 dBm tone within the range of 300 to 3000 Hz applied to input of the appropriate selector module shall produce a +25 dBm output at the speaker terminals. With the speaker volume control fully counterclockwise, the speaker output signal shall be +5 dBm. By selection of a strap option, all of these requirements shall also be met with a -20 dBm input signal.

Page 18, add the following two paragraphs:

"3.6.4.10 Option X audio. A foldback audio path shall be provided at the position recorder connector which when switched through external switching equipment (not part of this specification) shall apply the received balanced audio output from the headset amplifier to the speaker buss in the audio unit at a point in the circuit prior to the speaker volume controls )3.3.1.1)."

"3.6.4.10.1 Option X speaker output. With the loudspeaker and headset volume controls (3.3.1.1, 3.3.1.2) set for maximum output, apply either a -20 dBm or -28 dBm signal to the input of any selector unit module. The input signal level shall be dependent on the strap optin setting (3.6.4.5, 3.6.4.6). The selector module shall have the headset selected. Activating the Option X circuit via external switching equipment shall result in the headset received audio being applied to the speaker buss through foldback interface circuitry which shall in turn result in a minimum of +25 dBm at the speaker terminals, with only one headset plugged into the jack unit."

Page 18, paragraph 3.6.5: Add the following: "A screwdriver type level control shall be provided in the audio unit to adjust the mixer circuit output with the transmit output level (3.6.2.3) set between any level between 0 dBm and -10 dBm."

3.6.5.1 Input-output levels. - Delete and substitute: "With a -30 dBm signal applied at either input from the telephone system (3.4.1.3), a -20 dBm or -28 dBm signal at any receiver channel input (3.6.4.5, 3.6.4.6) with either the headset or loudspeaker selected, or any level signal between -11 dBm and +9 dBm at either headset input, the mixer cirucit shall be provided with a level control to adjust the mixer output between 0 dBm and -10 dBm to the external recorder. The selected mixer output level shall not vary by more than 2 dB when any of the specified signal input levels at 1 KHz are applied to the equipment. Interaction between level controls, the headset or loudspeaker control shall not exceed 1 dB.

Page 18, paragraph 3.8.2.2: In line 13, delete "for a microphone and headset" and substitute "on the front panel for operation with both headsets and jack unit.".

Page 22, paragraph 3.13.8: In line 4, after "Paragraph 1-3.6.6" delete the period and add "of FAA-G-2100."

Page 22, paragraph 3.13.17.1. - Change "50/60 Hertz" to "60 Hertz."

Page 24 paragraph 4.2.2: Add the following paragraphs under Systems (12 position and 24 radio channels): "3.3.2.1.1; 3.3.2.1.2; 3.3.2.1.3; 3.3.2.1.4; 3.3.3.1; 3.3.3.1.4; 3.6.2.6; 3.6.4.2; 3.6.4.4; 3.6.4.7; 3.6.4.9; 3.13.6.1".

Page 26, paragraph 4.7.1: Delete.

* * * * *

FAA-E-2290c
**January 20, 1975**
SUPERSEDING
FAA-E-2290b
February 11, 1971

# DEPARTMENT OF TRANSPORTATION
## FEDERAL AVIATION ADMINISTRATION
## SPECIFICATION

CONTROL EQUIPMENT, RADIO CHANNEL

1. SCOPE AND CLASSIFICATION

1.1 Scope.- The equipment covered by this specification will be used in air traffic control towers and flight service stations to perform all the audio switching, processing, and mixing functions required for use with the facility transmitters, receivers, and voice recorders. Basically, the equipment consists of a jack unit, an audio unit complete with modules, a selector unit complete with modules, an interposition cable and/or patch panel unit and an optional power supply. The 24V DC power supply is solid-state and modular in construction.

1.2 Classification.- Two types of selector units are specified herein, differing in terminations and wiring, as described in the referenced paragraphs listed below:

| | |
|---|---|
| Type I | ATCT Selector Unit (3.3.2) |
| Type II | FSS Selector Unit (3.3.3) |

2. APPLICABLE DOCUMENTS.

2.1 FAA specifications.- The following FAA specifications, of the issues specified in the invitation for bids or request for proposals, form a part of this specification:

| | |
|---|---|
| FAA-G-2100/1 | Electronic Equipment, General Requirements; Part 1 - General Requirements for all Equipments |

| | |
|---|---|
| FAA-G-2100/3 | Electronic Equipment, General Requirements; Part 3 - Requirements for Equipments Employing Semiconductor Devices |
| FAA-G-2100/4 | Electronic Equipment, General Requirements; Part 4 - Requirements for Equipments Employining Printed Wiring Techniques |
| FAA-G-2100/5 | Electronic Equipment, General Requirements; Part 5 - Requirements for Equipments Employing Microelectronic Devices |
| FAA-D-2494 | Instruction Books, Electronic Equipment |
| FAA-STD-013 | Quality Control Program Requirements |

(Copies of this specification, and of other applicable FAA specifications and drawings, may be obtained from the Federal Aviation Administration, Washington, D. C. 20590, ATTN: Contracting Officer. Requests should fully identify material desired, i.e., specification numbers, dates, amendment numbers, complete drawing numbers; also, requests should state the contract involved or other use to be made of the requested material.)

2.2 Military publications.- The following military publications, of the issues in effect on the date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified hereinafter:

| | |
|---|---|
| MIL-HDBK-217A | Reliability and Failure Rate Data for Electronic Equipment |
| MIL-STD-721B | Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors, and Safety |
| MIL-E-17555 | Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of |

Single copies of Military Specification and Standards may be requested by mail or telephone from U. S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120 (for telephone requests, call (215) 697-3321, 8 a.m., to 4:30 p.m. Monday through Friday). Not more than five items may be ordered on a single request; the Invitation for Bid or Contract Number should be cited where applicable. Only latest revisions (complete with latest amendments) are available.

## 3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor. Each equipment furnished by the contractor shall be complete and in accordance with all specification requirements. The contractor shall furnish the quantities of each type (1.2) of selector units specified in the contract. Instruction books shall be furnished in accordance with FAA-D-2494, and as specified in the contract

3.2 Definitions

3.2.1 Design-center values.- Modify 1-3.2.21 of FAA-G-2100/1 as follows: Delete all references to AC line voltage and frequency. In the last line, change "48 V" to "24 V."

3.2.1.1 Design-center values (optional power supply 24V DC).- Modify 1-3.1.21 of FAA-G-2100/1 as follows: The AC line voltage shall be 120V AC 50-60 Hz.

3.2.2 Normal test conditions.- Modify 1-3.2.22 of FAA-G-2100/1 as follows: Delete all references to AC voltage and frequency. In the last line, change "48 V $\pm$1 V" to "+24 V $\pm$0.5 V."

3.2.2.1 Normal test conditions (optional power supply 24V DC).- Modify 1-3.2.22 of FAA-G-2100/1 as follows: Change 60 Hz to 50/60 Hz.

3.2.3 Service conditions.- Modify 1-3.2.23 of FAA-G-2100/1 as follows: Delete all references to AC line voltage and frequency. In line 15 change "DC voltage (48 V)" to "DC voltage (24 V)." Also change "33 V to 52 V" to "22.5 V to 26.0 V." Finally, add the following: "DC power source ripple: 100 mV $\pm$5 mV peak to peak."

3.2.3.1 Ambient conditions (optional power supply 24V DC).- The ambient condition shall be 0 to 50°C with 5 to 90 percent humidity (modifies FAA-G-2100/1).

3.2.4 Ambient conditions.- The ambient conditions are defined as the conditions of Environment I (1-3.2.23, FAA-G-2100/1).

3.2.5 Position.- The term "position," as used herein, shall denote a functional grouping of control equipment in an air traffic control facility used by an air traffic control specialist. The position shall consist of a jack unit, an audio unit complete with modules, one to three selector units complete with modules, an interposition cable and/or patch panel unit including optional power supply.

3.2.6 System.- A system shall consist of any size from a minimum of two operating positions and four radio channels to a maximum of twelve operating positions and twenty-four radio channels.

3.3 Functional requirements

3.3.1 Audio unit.- The audio unit contains the position loudspeaker, mounted behind a front panel grille, and performs all the audio amplification, mixing, control, and display functions common to the operating position. Except for

Relays shall not be used to perform any functions as specified herein except to operate dry keying contracts in accordance with Paragraph 3.6.3.3.

3.3.2.1 Transmitter selector switch assembly.- The transmitter selector switch assembly, mounted on the selector unit module front panel, shall contain the transmitter selector switch and lamp, the transmit lamp, the receiver syllabic lamp, and the channel frequency designations. When the indicator lamps are illuminated they shall be readily visible in the sunlight.

3.3.2.1.1 Transmitter selector switch.- Placing the selector switch in the on position and closing the position push-to-talk switch, shall activate the associated selection circuitry which will cause the transmitter keying signal and the transmit amplifier audio output to appear at the output terminals that are assigned to the selected radio channel. When the switch is in the selected mode, the upper left qradrant of the lens associated with each selector switch shall glow green indicating that the transmitter has been selected. Placing the selector switch to the off position, removes the transmitter keying signal and transmit amplifier audio output from the associated output terminals. All transmitting selector switches shall have a three - position lever, two positions normal operation and one position spring loaded return operation. For emergency operation the selector switch shall be inhibited from being placed in "normal on position" by some mechanical feature which shall be provided with each switch and which cannot inhibit the spring return position.

3.3.2.1.2 Channel selector and transmit lamps.- The channel selector and transmit lamps shall be located in the upper half of the lens associated with each transmitter selector switch. When a transmitter is selected the associated channel selector lamp shall glow green in the upper left quadrant. When the selected channel is keyed the associated transmit lamp at the keying position, as well as the associated transmit lamps at all other operating positions having access to that particular transmitter, shall glow red in the upper right quadrant. Placing the selector switch to the off position which was already selected and keyed (green and red lamps on) shall remove the transmitter keying signal and transmit amplifier audio output from the associated output terminals and cause the green and red lamps to be extinguished.

3.3.2.1.3 Receiver syllabic lamp.- The receiver syllabic lamp shall be located in the lower half of the lens associated with each transmitter selector switch, and shall be amber in color. When an audio signal is appearing on a receiver channel, the receiver syllabic lamp associated with the channel shall flash at a syllabic rate at all operating positions where the channel appears.

3.3.2.1.4 Channel frequency designations.- The channel frequency designations, consisting of five block numerals and a decimal point (e.g., 132.35), shall be displayed on the face of the transmit lamp and on the face of the receiver syllabic lamp. The block numerals shall be a minimum of 1/8 inch high. The lens shall have some means for holding and protecting the frequency designation, and it shall be possible to remove and replace the designation easily and without special tools. The designations shall be faintly backlit at all times to permit legibility in total darkness as well as daylight. Two hundred fifty five (255) frequencies shall be furnished with

each selector unit which are as follows:

a. 118.0 MHz - 121.4 MHz (increments of 0.05 MHz)
b. 121.50 MHz
c. 123.60 MHz - 128.80 MHz (increments of 0.05 MHz)
d. 132.05 MHz - 135.95 MHz (increments of 0.05 MHz)
e. 243.00 MHz

Each frequency shall be printed twice on each insert for the transmit lamp and for the receive syllabic lamp.

3.3.2.2 Receiver selector switch.- A three-position level switch shall be mounted on the selector unit module front panel. The switch shall control the receiver audio from the associated radio channel. When the switch is in the center (off) position, the receiver audio circuit from the associated radio channel shall be open at the switch. When the switch is in the down (headset) position, receiver audio shall be routed to the input of the headset amplifier, and when the switch is in the up (loudspeaker) position, receiver audio shall be routed to the input of the loudspeaker amplifier. All receiver selector switches shall have the extra locking feature incorporated in the switches so that the switches can be locked in any position.

3.3.3 FSS selector unit (Type II).- The selector unit shall perform the control, muting, adjustment of audio level, selection, and display functions required for individual radio channels at each operating position where the channels appear. The components for each radio channel shall be constructed on an individual plug-in module. Each selector unit shall be capable of holding up to eight plug-in modules. The modules shall be removable from the front of the selector unit. The number of channels controlled from a given operating position may be increased by adding additional selector units, up to a maximum of three units (24 radio channels). When less than eight modules are to be used, it shall be possible to remove the unused modules and replace them with blank panels without affecting normal system operation. Paragraphs 3.3.2.1 through 3.3.2.2 and 3.3.3.1 through 3.3.3.2 shall apply to the Type II selector unit. Relays shall not be used to perform any functions as specified herein except to operate dry keying contacts in accordance with Paragraph 3.6.3.3.

3.3.3.1 Muting switch.- A three-position lever switch shall be mounted on the selector unit module front panel. When the switch is in the center (normal) position, the receiver audio is controlled with the receiver selector switch as if the audio muting circuit is not connected. When one or more muting switches are in the down (mute) position, the receiver audio associated with those switches shall be attenuated from 6 to 30 dB at the audio unit speaker or headphone jack, depending upon the setting of the "mute level adjust" control. Likewise, when one or more switches are in the up (mute all others) position, the receiver audio for all channels except those associated with the switches in the up position shall be attenuated from 6 to 30 dB. A method shall also be provided for altering the muting switch function in such a manner that it maintains the "mute all others" function, but will prevent the mute switch in other channels

from muting the particular channel which has been so altered. Operation of the receive syllabic lamp shall not be affected by the muting switch. A means of disabling the audio muting circuit shall be provided on each selector unit module. All muting switches shall have the extra locking feature incorporated in the switches so that the switches can be locked in any position.

3.3.3.1.1 Mute level adjust.- A "mute level adjust" screwdriver type control shall be provided on each module to permit control of the muting level of the associated channel's output. The control shall only be accessible when the maintenance card extender is used. When a channel is in a muted condition, the control shall permit adjustment of the muted signal over the range from 6 dB to 30 dB below the unmuted signal level as the control is adjusted in a clockwise direction.

3.3.3.1.2 Receiver audio circuits.- The electrical characteristics specified for the receiver audio circuits shall not be degraded by the mute level adjust circuitry. The single exception to this requirement is specified in the following paragraph.

3.3.3.1.3 Mute circuit insertion loss.- When all volume controls are fully clockwise and all muting switches are in the normal position, the output levels at the headset jack and loudspeaker as specified in Paragraphs 3.6.4.5 and 3.6.4.6 shall not be degraded more than 2 dB.

3.3.3.1.4 Mute lamp.- A muting lamp complete with a red lens shall be provided on the front panel of each module. The mute lamp shall flash at a rate of 40 to 80 times per minute with a 50/50 on-off ratio when the associated channel is in the muted condition.

3.3.3.1.5 Channel frequency designation.- The channel frequency designation shall be displayed on the lens of the mute lamp in accordance with Paragraph 3.3.2.1.4.

3.3.3.2 Volume control.- A volume control shall be mounted on the selector unit module front panel. The volume control shall permit adjustment of 6 dB of the audio level for the loudspeaker. This control shall be in addition to the master control in the audio unit.

3.3.4 Jack unit.- The jack unit permits connection of the position handheld microphone or the position headset (external equipments not covered by this specification) to the audio unit at a location remote (up to eight feet) from the position audio unit.

3.3.5 Patch panel.- The patch panel or panels, when used, provide the interface between the operating positions and up to 24 channels of external radio equipment common to several or all of the positions. Each patch panel performs the patching function for three operating positions. Using additional patch panels increases the patching capability in multiples of the three positions up to a maximum of 12 positions when four patch panels are used.

3.3.5.1 Fixed patchboard.- A triple-deck fixed patchboard shall be mounted on the patch panel front panel. The top half of each patchboard deck shall be wired to position equipment connectors on the rear of the patch panel chassis, for interface, through external cables, with radio equipment connectors on the selector unit chassis at the associated operating position. The bottom halves of the three patchboard decks shall be paralleled to radio equipment connectors on the rear of the patch panel chassis for interface with the external radio equipment and for connection to additional patch panels when more than three operating positions must be served.

3.3.5.2 Programming patch cords.- Twenty-four programming patch cords shall be furnished for and shall mate with each patchboard deck. Through use of the programming patch cords, each transmitter/receiver selector switch pair at the associated operating position may be matched with any desired radio channel. The programming patch cord length shall be a minimum of two (2) feet long.

3.3.5.3 Radio channel patch cords.- One complete set of radio channel patch cords shall be supplied with each patch panel. They shall be used to interconnect radio channels of other patch panels. The radio channel patch cord length shall be a minimum of four (4) feet long.

3.3.6 Interposition cable.- When the patch panel is not used, the interposition cable performs the function of connecting together multiple operating positions and connecting them to the external radio equipment cable common to all the operating positions.

3.4 Interface requirements

3.4.1 Audio unit.- Five chassis-type latching connectors shall be mounted on the rear of the audio unit chassis. A mating cable-type latching connector shall be furnished with each chassis-type connector except for the intraposition cable connector and the jack unit connector.

3.4.1.1 DC power connector.- Direct current for the jack, audio and associated selector units at an operating position enter the audio unit through this polarized, latching connector.

3.4.1.2 Tape recorder connector.- The tape recorder connector shall contain the output leads from the recorder mixing circuit and the input leads to the recorder monitor lamp circuit.

3.4.1.3 Telephone system connector.- The telephone system connector shall contain two external inputs from the telephone system to the recorder mixing circuit, the headset amplifier output, and push-to-talk circuit input. The telephone received audio and the headset received audio are parallel internally to the headset amplifier output. The telephone transmit audio path shall enter the jack unit through a balanced pad. The input impedance of the telephone transmit line at the pad shall be 600 $\pm$100 ohms.

3.4.1.4 Intraposition cable connector.- The intraposition cable connector shall extend the transmit amplifier output, push-to-talk signals, and DC power to an adjacent selector unit, and shall receive busy tone control signals, headset amplifier input signals, and loudspeaker amplifier input signals from the adjacent selector unit. The connector shall mate with the male cable-type connector terminating the end of the intraposition cable.

3.4.1.5 Jack unit connector.- The jack unit connector shall extend the DC voltage from the audio unit; the headset amplifier output from the volume control module; and the transmit audio from the telephone circuits to the jack unit. The jack unit connector shall also receive low level transmit audio and push-to-talk signals from the jack unit. The connector shall mate with the male cable - type connector terminating the end of the jack unit cable.

3.4.2 Selector unit.- Three chassis-type latching connectors shall be mounted on the rear of the selector unit chassis. A multiconductor cable shall extend from the rear of the selector unit chassis, and shall be terminated in a male cable-type latching connector. Three mating cable - type shall be furnished with the three chassis type latching connectors for each selector unit.

3.4.2.1 Intraposition cable.- The intraposition cable shall be at least four feet in length. The terminating connector shall mate with either the intraposition cable connector on the position audio unit or with the intraposition cable connector on an adjacent selector unit. The cable shall extend busy tone control signals, headset amplifier input signals, and loudspeaker amplifier input signals to the adjacent audio or selector unit, and shall receive transmit amplifier output signals, push-to-talk signals, and DC power from the adjacent unit.

3.4.2.2 Intraposition cable connector.- The functions of the selector unit intraposition cable connector shall be identical to those of the audio unit intraposition cable connector.

3.4.2.3 Radio equipment connectors.- Two male radio equipment connectors shall each contain eight individually shielded audio pairs and twelve additional unshielded conductors. This total provides a shielded transmitter audio pair, a shielded receiver audio pair, a transmitter keying pair, and an interlock wire for each of four radio channels. Multiple operating positions are paralleled to individual radio channels at this point, either through the use of interposition cables or the optional patch panel.

3.4.3 Jack unit.- The jack unit shall contain a microphone jack, a headset jack, and a multiconductor cable, at least eight feet in length. The cable shall extend from the rear of the jack unit chassis and shall be terminated with a male cable-type latching connector. The jack unit shall be electrically and mechanically compatible with a Plantronics type Star Set HS 0111 equivalent and shall provide the necessary DC and signal voltages for proper operation of the equipment.

3.4.3.1 Microphone jack.- A four-pin (two transmit audio and two push-to-talk) threaded microphone jack shall be mounted on the jack unit front panel. The jack shall be Amphenol part number 91PC4F or equal.

3.4.3.2 Headset jack.- A headset jack suitable for mating with a JAN type PJ-511 plug shall be mounted on the jack unit front panel.

3.4.3.3 Jack unit cable.- The jack unit cable shall extend the transmit audio and push-to-talk signals to the position audio unit, and shall receive DC voltage, headset amplifier output and telephone transmit audio from the audio unit. The terminating connector shall mate with the jack unit connector on the position audio unit.

3.4.4 Patch panel.- Thirty male chassis-type latching connectors shall be mounted on the rear of the patch panel chassis. A mating cable-type connector shall be furnished with each chassis-type connector.

3.4.4.1 Position equipment connectors.- Three groups of six connectors each shall be designated position equipment connectors. Each group of six connectors shall interface, through external cables, with the radio equipment connectors on the selector units at one of the operating positions. Internally, each group of six connectors shall be wired to the top half of one of the patchboard decks.

3.4.4.2 Radio equipment connectors.- The remaining twelve connectors shall be designated radio equipment connectors. The twelve connectors shall be separated into six pairs of two connectors each, with each pair paralleled together as well as to the lower half of three patchboard decks. One connector from each pair shall interface through an external cable with the external radio equipment. The remaining connector from each pair shall be used to connect, in parallel, the radio equipment connectors from additional patch panels in order to increase the number of operating positions served from three to six, nine, or twelve positions.

3.4.5 Interposition cable.- Both ends of the interposition cable shall be terminated with female cable-type latching connectors. An additional cable, two feet in length, shall be pigtailed to one of the female connectors and terminated with a mating male cable-type connector. The connectors and pin assignments shall be designed to mate with the radio equipment connectors on the rear of each selector unit.

3.4.6 Interchangeability.- Each equipment furnished by the contractor shall be complete in accordance with all specification requirements. The Government furnished equipment (GFE) exemplifies the standard of workmanship, mechanical layout, and electrical characteristics desired. The equipment furnished by the contractor shall be electrically and mechanically interchangeable with similar items of the GFE. The mere duplication of the Government furnished equipment may not be sufficient to meet the requirements of this specification. In case of conflict between the design of the GFE and this specification, the specification shall take precedence.

3.5.8 Mounting holes.- The audio and selector units shall each have two #10 screw clearance holes in the top and bottom of the front panel to allow fastening the unit to the operating console. The hole centers shall be located on a horizontal line 15/64" in from the top and bottom edges of the front panel and spaced 3-34" from either side of each panel vertical centerline. Spacing for the jack panel mounting holes shall be 3/4" from either side of the panel vertical centerline. Location tolerance is ±1/64" in any direction.

3.5.9 Nameplate or nameplate information.- A nameplate shall be provided on each unit. This nameplate shall be in accordance with section 1-3.13 of Specification FAA-G-2100/1. The nameplate titles shall be as follows:

AUDIO UNIT

ATCT SELECTOR UNIT

FSS SELECTOR UNIT

JACK UNIT

PATCH PANEL

3.5.10 Welding.- The chassis shall be formed and continuously butt or fillet welded. All connecting edges shall be cleaned of foreign material and shall be dimensioned for proper fit-up. All welds shall be full penetration type and shall be smoothed (on the exterior of the chassis) by means of a belt sander or equal, maintaining the weld throat dimension not less than the thickness of the connecting metal. Chassis fabrication by rivating, screw fasteners, or spot welding not permitted.

3.6 Performance requirements.- The requirements of the following subparagraphs shall be met by systems of twelve operating positions and twenty-four radio channels. When required for testing, audio inputs and outputs interfacing with external equipment shall be properly terminated with 600 ohms plus or minus one percent resistors. The single exception to this requirement shall be the microphone jack, which shall be terminated with a 150 ohm plus or minus one percent resistor.

3.6.1 General performance requirements.- Each audio circuit shall meet the general performance requirements of the subparagraphs below.

3.6.1.1 Frequency response.- All audio paths through the units shall have a frequency response over the range of 300 to 3000 Hz that is within ±3 dB of the 1000 Hz response. The response shall continuously decrease above 3000 Hz and below 300 Hz.

3.6.1.2 Harmonic distortion.- The total harmonic distortion for each audio path through the units shall not exceed eight percent, using any test frequency in the range from 30 Hz to 3000 Hz. The input signal level to

the microphone jack for this test shall be -35 dBm, and the transmit amplifier output level control shall be adjusted to deliver between -5 dBm and 0 dBm to the transmitters audio terminals of any selected channel. The input signal level applied to the receiver audio terminals of any channel shall be -10 dBm. The headset volume control shall be set for maximum output. The speaker volume control shall be set for an output of two watts.

3.6.1.3 Hum distortion.- When a 1000 Hz signal is applied to an input, the total level of all hum distortion frequencies at the output of each audio path containing one or more push-pull stages shall be 30 dB below the output signal level. The input test levels shall be -55 dBm at the microphone jack and -20 dBm at all other inputs.

3.6.1.4 Noise.- With all inputs and outputs appropriately terminated, and with the level and volume controls set for maximum output, the noise level measured at any selected transmitter audio output channel shall not be greater than -40 dBm; the noise level measured at the recorder mixing amplifier output shall not be greater than -40 dBm; the noise level measured at the headset jack with all 24 receiver selector switches in the "headset" position shall not be greater than -40 dBm; and the noise level measured at the speaker input shall not be greater than -35 dBm.

3.6.1.5 Power consumption.- The equipment shall operate from an external source of +24 volts DC at 5 amperes. The maximum power consumed by each audio unit shall not exceed 20 watts. The maximum power consumed by each ATCT selector unit shall not exceed 45 watts and the maximum power consumed by each FSS selector unit shall not exceed 50 watts.

3.6.2 Transmitter audio circuit.

3.6.2.1 Transmit amplifier.- A regulating amplifier shall be located in the audio unit and shall amplify and regulate audio signals applied to the microphone jack, headset jack, or telephone system connector.

3.6.2.1.1 Jack unit circuit.- The jack unit shall control the path for three transmit audio lines: telephone, headset, and microphone. When keying anyone of the three inputs, only that input which is keyed shall transmit audio to the transmit amplifier. Under these conditions the two inputs that are unkeyed shall each be isolated a minimum of 50 dB from the transmit path. The order of keying priority are headset first, telephone second, and microphone third. The higher priority keying circuit shall have the capability to override the lower priority keying circuit. When none of the three inputs are keyed, only the microphone shall have an audio path to the transmit amplifier.

3.6.2.2 Input impedance.- The transmit amplifier input impedance, measured at the microphone jack, shall be 150 ohms plus or minus 50 ohms. At the telephone system connector, the input impedance shall be 600 ohms plus or minus 100 ohms. The headset transmit input, measured at the headset jack, shall be 50 ohms $\pm$20 ohms. (The headset is designed to work into an effective load impedance of 50 ohms $\pm$20 ohms at 1000 Hz and a current drain of 50 to 100 ma.).

3.6.2.2.1 Input circuit.- A solid-state switching device shall be provided so that the transmitter amplifier is inoperative during non-transmitting periods. The solid-state switching device shall be placed in the Mic. Amp./ Lamp Brightner Module or the audio unit proper.

3.6.2.2.2 Input level control.- An input level control shall be provided with maximum input occurring when the control is in a fully clockwise position. The control shall permit adjustment of the input level over a total range of 20 dB ±3 dB. The control shall be mounted on the transmit amplifier printed circuit card and shall be accessible for screwdriver adjustment through the use of a module test adapter.

3.6.2.3 Output level control.- An output level control shall be provided with maximum output occurring when the control is in a fully clockwise position. The control shall permit adjustment of the output level over a total range of 25 ±5 dB. The control shall be accessible for screwdriver adjustment through the use of a module or card test adapter.

3.6.2.4 Output level.- When a 1000 Hz -55 dBm signal is applied to the microphone jack, and the output level control is fully clockwise, the signal level at the appropriate selector unit radio equipment connector for any selected channel shall be between -5 dBm and 0 dBm. The difference in output level between any two selected channels at a position shall not be more than 2 dB. Additionally, when a 1000 Hz, -30 dBm signal is applied to the auxiliary telephone microphone jack and when a 1000 Hz, -11 dBm signal is applied to the headset microphone input, either path when keyed shall result in an output level between -5 dBm and 0 dBm.

3.6.2.5 Output transformer.- An output transformer shall be used for each transmitter channel and shall be located in each selector unit module. The transformer secondary shall be ungrounded.

3.6.2.6 Output impedance.- The output impedance of each transmitter audio channel, measured under keyed conditions at the selector unit radio equipment connector shall be 600 ohms plus or minus 100 ohms.

3.6.2.7 Regulating range.- With an input signal of 1000 Hz at -55 dBm, the output level control set to maximum output and the regulator control set to start regulation at any value within the range of -5 dBm to 0 dBm, a slow (approximately two seconds) increase in input signal to -35 dBm shall not cause the output to change by more than 3 dB.

3.6.2.7.1 Regulator control range.- With an input signal of 1000 Hz at -55 dBm and the output level control set for maximum output, the range of adjustment of the regulator control shall be such that regulation starts at all values within the range of -5 dBm to 0 dBm at the output of the regulated amplifier. The regulator control shall provide sufficient range such that an input signal of -35 dBm will provide an output of ±10 dBm.

3.6.2.7.2 Regulation switch.- A switch shall be provided to disable the DC feedback regulation voltage and shall be located inside the amplifier module.

3.6.2.8 Regulator attack time.- If the 1000 Hz, -55 dBm input signal is suddenly raised 20 dB to -35 dBm, the output level shall be within plus or minus 1.5 dB of the final steady state value within 10 milliseconds from the instant of input level change. This characteristic shall be measured under normal test conditions.

3.6.2.9 Regulator release time.- If a steady state 1000 Hz -35 dBm input signal is suddenly decreased from -35 dBm to -55 dBm, the output level shall stabilize to within 3 dB of the final steady-state value no sooner than 300 milliseconds, and no later than 600 milliseconds after the instant of input level change. This characteristic shall be measured under normal test conditions.

3.6.2.10 Sidetone circuit.- A sidetone circuit in the audio unit shall couple a portion of the transmit amplifier output to the headset amplifier input. With a 1000 Hz -55 dBm signal applied to the microphone jack, and with the headset volume control set for maximum output, the sidetone level measured at the headset jack shall be between -23 and -27 dBm. The sidetone level shall be independent of the transmitter audio output level control setting. Sidetone shall not appear in the speaker.

3.6.2.11 Transmitter channel loading.- The output from a selected transmitter channel shall not change more than 3 dB as the number of selected channels at a position is increased from one channel to twenty-four channels.

3.6.2.12 Transmitter channel crosstalk.- With a 1000 Hz signal at -35 dBm applied to the microphone jack, and one or more transmitter channels keyed, the crosstalk level appearing at the output of any unkeyed transmitter channels shall be less than -40 dBm. Furthermore, when "loudspeaker" is selected for one or more channels, and the loudspeaker volume control is fully clockwise, crosstalk from the transmitter channel, measured across the loudspeaker terminals, shall be at least 35 dB down from the normal level measured with volume control fully clockwise and a -10 dBm 1000 Hz signal applied to that receiver channel.

3.6.2.13 Regulator control.- A regulator control shall be provided for adjusting the output level. The adjustment shall be the screwdriver type and shall increase the output level when turned in a clockwise direction. Limitation of control range shall be achieved without the use of special mechanical stops. The control shall be located inside the Mic. Amp./ Lamp Brightener module.

3.6.3 Transmitter keying circuit.- The transmitter keying circuit shall apply a transmitter keying signal to the appropriate terminals on the selector unit radio equipment connector, for any selected transmitter channel not already keyed, whenever a short is applied to the microphone jack push-to-talk terminals.

3.6.3.1 Push-to-talk switch current.- When any number from one to twenty-four transmitter channels are keyed simultaneously, the current through the shorted microphone jack push-to-talk terminals shall not exceed 50 mA.

3.6.3.2 Switching time.- The time interval from the instant the push-to-talk terminals on the microphone jack are shorted until a keying signal and transmitter audio appear at the appropriate leads of the selector unit radio equipment connector shall not exceed 50 ms for any selected channel.

3.6.3.3 Transmitter keying contacts.- Each selector unit module shall contain a set of dry keying contacts. When a transmitter selector switch is depressed, the push-to-talk terminals on the position microphone jack are shorted, and the transmitter channel is not busy at another operating position, the dry keying contacts shall close, sending a keying signal to the appropriate transmitter. The contacts shall be rated at 15 volt-amperes, 1 ampere maximum, into a resistive load. The contact life, in number of operations at rated current and voltage before the contact resistance exceeds 100 milliohms, shall exceed 50 million operations. Dry keying contacts, as stated herein, shall denote an additional set of contacts with no voltage applied to the contacts.

3.6.3.4 Interlock.- An interlock circuit shall prevent the application of transmitter audio to a transmitter channel from more than one operating position at a time. When a transmitter channel is busy, the appropriate transmit lamp shall glow at each operating position where the channel appears. If an operator selects and attempts to key a busy transmitter channel, a busy-tone generator shall instead be energized at the offending operating position. The busy-tone generator, located in the audio unit, shall generate a busy tone which shall be audible in the position speaker as well as in the position headset. The busy tone shall warn the operator that he is attempting to key a busy channel. A single wire between adjacent operating positions, appearing at the selector unit radio equipment connector, shall control the interlock, transmit lamp enable, and receiver audio muting functions together. It shall be possible to parallel any number of operating positions from two through twelve to a single receiver channel without affecting the operation of the interlock/transmit lamp/receiver muting circuit.

3.6.4 Receiver audio circuit.

3.6.4.1 Input transformer.- An input transformer shall be used for each receiver channel and shall be located in each selector unit module. The transformer primary shall be ungrounded.

3.6.4.2 Input impedance.- The input impedance of each receiver channel, measured at the selector unit radio equipment connector, shall be 1800 ohms plus or minus 300 ohms.

3.6.4.3 Receiver syllabic lamp.- The receiver syllabic lamp shall be of the incadescent type and shall flash at a syllabic rate in the presence of an audio signal at the receiver audio channel input. An input level to the selector unit module of -30 dBm shall just be sufficient to cause the lamp to glow, while a level of -10 dBm shall light the lamp to normal brilliance. Syllabic lamp operation shall be independent of the position of the channel receiver selector switch.

3.6.4.4 Receiver audio muting.- A muting circuit shall be supplied in each receiver channel and shall automatically attenuate the incoming receiver audio a minimum of 50 dB at all operating positions whenever the associated transmitter channel is selected and in a keyed condition.

3.6.4.5 Headset amplifier.- A headset amplifier shall be located in the audio unit. With the headset volume control set for maximum output, the regulator switch to "OFF" position and any receiver selector switch in the "headset" position, a -20 dBm 1000 Hz tone delivered to the appropriate selector unit module shall result in a minimum output signal of +10 dBm at the headset jack. The amplifier shall contain a regulation circuit limiting the output to 0 dBm $\pm$1 dB when the regulator switch is in the "ON" position. With the regulator switch in the "ON" position, and the input signal levels between -20 dBm and +10 dBm, the headset amplifier shall meet the specification requirements. With the headset volume control set for minimum input and under the same above conditions, a minimum output signal of -20 dBm shall result at the headset jack.

3.6.4.5.1 Regulating range.- With an input signal of 1000 Hz at -20 dBm, set the gain control to give an output level of +10 dBm without regulation. With the regulator switch to the "ON" position, a slow (approximately two seconds) increase in input signal to -10 dBm or higher shall not cause the output signal to increase by more than 2 dB.

3.6.4.5.2 Regulation attack time.- Under the conditions of 3.6.4.5.1, a sudden increase in the input signal level from -20 dBm to -10 dBm or higher shall not cause an oscillatory type output level, including transients, to increase by more than 5 dB or decrease by more than 3 dB. The output level shall be within $\pm$1.5 dB of the final steady state value within 10 milliseconds from the instant of input level change.

3.6.4.5.3 Regulation release time.- Immediately following the 10 milliseconds stabilization period of 3.6.4.5.2, with a sudden decrease in the input signal level from -10 dBm or higher to -20 dBm, the output level shall stabilize to within 3 dB of the final steady state value in not less than 300 milliseconds but in not more than 600 milliseconds from the instant of input level change.

3.6.4.5.4 Regulation switch.- A switch shall be provided to disable the DC feedback regulation voltage and shall be located inside the amplifier module.

3.6.4.6 Loudspeaker amplifier.- A loudspeaker amplifier shall be located in the audio unit. With the loudspeaker volume control set for maximum output, and any receiver selector switch in the "loudspeaker" position, a -20 dBm 1000 Hz tone delivered to the appropriate selector unit module shall result in a minimum signal of 1.1 volts rms across the speaker terminals. With the loudspeaker volume control set for minimum input and under the same above conditions, a minimum output signal of 0.11 volts rms shall result across the speaker terminals.

3.6.4.7 Receiver channel loading.- The headset and loudspeaker output shall not be degraded more than 3 dB as the number of receiver selector switches simultaneously in the "loudspeaker" (or "headset") position is increased from one to twenty-four.

3.6.4.8 Receiver channel crosstalk.- With a -10 dBm 1000 Hz signal at the receiver audio input terminals of any channel, no combination of receiver selector switch positions shall result in more than a -50 dBm crosstalk signal appearing at the receiver audio input terminals of any other channel. Furthermore, no crosstalk signal level greater than -40 dBm shall appear at the transmitter audio terminals of any selected and keyed transmitter channel when the transmitter audio output level control is fully clockwise. The headset and speaker volume controls shall also be fully clockwise.

3.6.4.9 Speaker-headphone crosstalk.- When the receiver selector switch is moved from the HS position to either the OFF or the LS position, the headset output shall drop by a minimum of 50 dB. Also, when the receiver selector switch is moved from the LS position to to either the OFF or the HS position, the loudspeaker output shall drop by a minimum of 50 dB. The signal level at the receiver audio input terminals shall be -10 dBm at 1000 Hz.

3.6.5 Recorder mixing circuit.- The recorder mixing circuit shall be located in the audio unit. At each position, audio signals from the transmit amplifier, headset amplifier, loudspeaker amplifier, and two external inputs from the telephone system through the tape recorder connector, shall be mixed into a single audio output. The single mixed output shall then be applied to a recording channel external to the equipment described in this specification.

3.6.5.1 Input-output levels.- With an audio signal level of -30 dBm at either of the external inputs from the telephone system, -20 dBm at any receiver channel input having either headset or loudspeaker selected, or any level between -55 dBm and -35 dBm at the microphone jack, the mixing circuit output shall be -10 dBm +2 dB. The input level to the mixing circuit from the loudspeaker, headset, and microphone amplifiers shall be taken after the respective volume or level controls.

3.6.5.2 Isolation.- Isolation between any two mixing circuit inputs shall be a minimum of 50 dB.

3.6.5.3 Output impedance.- The mixing amplifier shall meet all specification requirements with an output load of 600 ohms ±100 ohms.

3.6.5.4 Input impedance.- The input impedance seen at either of the two external mixing circuit inputs shall be 600 ohms ±100 ohms.

3.6.6 Recorder monitor lamp circuit.- An audio signal level of -30 dBm at the recorder monitor lamp circuit input shall just be sufficient to cause the recorder monitor lamp to glow, while a level of -10 dBm shall light the lamp to full brilliance. The input impedance to the circuit shall be 600 ohms ±100 ohms.

3.6.7 Busy-tone circuit.- A busy-tone generator in the audio unit shall sound an audible tone in the operating position speaker and headset when the operator attempts to select and key a busy transmitter channel. The busy-tone generator is activated by the combination of a busy signal on the appropriate channel interlock wire on the selector unit radio equipment connector, a depressed transmitter selector switch, and shorted push-to-talk contacts on the microphone jack.

3.7 Reliability requirements.- The contractor shall prepare a reliability prediction report in accordance with MIL-HDBK-217A. The report shall contain failure rate data on each part and on each circuit card used in the design. The predicted mean-time-between-failure (MTBF) shall be at least 20,000 hours for the audio unit and at least 20,000 hours for the selector unit based on the following conditions:

1. Operation under service conditions of maximum voltage and temperature.

2. Switches operated once per hour.

3. Push-to-talk circuit operated 20 times each hour.

4. Service life of 15 years, operating 24 hours per day and seven days per week.

3.8 Maintainability.- The equipment design shall be such that a maximum possible equipment utilization, consistent with high reliability, will be realized through maintainability practices. Module test adapters and test sets shall be provided to facilitate maintenance. Corrective and preventive maintenance shall be considered on the following basis:

1. Corrective Maintenance - In the event of a failure, it shall be possible to restore the equipment to an operational condition within five minutes. This fault correction time is based on removing and replacing with a like module or circuit card.

2. Preventive Maintenance - Preventive maintenance shall be unnecessary or greatly reduced.

3.8.1 Special tools and test equipment.- The contractor shall supply with eac radio channel control equipment any special tools and any special test equipme required to maintain this equipment, including lamp puller, etc.

3.8.2 Optional test equipment.- As may be provided in the contract schedule, equipment shall be furnished as specified in the following subparagraphs. A suitable portion of the Radio Channel Control Equipment Instruction Book shall be devoted to these equipments. The equipment shall be designed so that it will not interfere with nor be susceptible to any environmental disturbance (see paragraph 3.9).

3.8.2.1 Module test adapter.- The adapter shall be designed to permit all types of modules to be extended six feet from the control equipment for in-service testing. The construction of the adapter shall be such that when it is plugged into the control equipment, in the place of a module, and the defective module is plugged into the adapter, the electronics of the module will be exposed for servicing.

3.8.2.2 Test set.- A test set shall be furnished to duplicate the supports, guides, connectors, interwiring, input and output of all types of modules used in the radio channel control equipment. The test set shall be designed to permit clear access to all connections for bench operation of all types of modules. Input-output terminal strips shall also be provided to extend the signal and DC voltages. The test set shall be such that the module test adapter can be used, at the maintenance personnel's option, to extend and expose all the sides of all types of modules. The test set shall be designed with a self-contained power supply, audio oscillator with test frequencies of 300, 1000, and 3000 Hzs, a meter to measure all the proper levels of operations, including the power supply output voltage, an output audio speaker with ON/OFF switch, and a full set of modules including Types I and II, including input connectors for a microphone and headset.

3.9 Interference.- The equipment shall be designed to function in an air traffic control tower and flight service station environment. It shall not interfere with, nor be susceptible to, any environmental disturbance which causes or can cause undesired response, malfunction, or degradation of performance. The equipment shall be properly shielded and have the necessary filtering to prevent interference caused by coupling and conduction.

3.10 Design plan.- The contractor shall submit a preliminary design report including an electronics device complement to the contracting officer for review and approval. The plan shall include drawings showing the configuration of all chassis, panels, and circuit boards, with parts layouts and schematic diagrams.

3.11 Electron devices.- All active electron devices and diodes used in this equipment shall be semiconductor devices and they shall be protected against surges and transients in accordance with FAA-G-2100/3.

3.11.1 Printed wiring techniques.- Printed wiring boards shall be used wherever feasible and shall be in accordance with FAA-G-2100/4.

3.11.2 Microelectronic devices.- Microelectronic devices shall be used wherever feasible and shall be in accordance with FAA-G-2100/5.

3.12 Optional prototype equipment.- Prototype equipment shall meet all requirements of this specification except as modified by the following subparagraphs.

3.12.1 Design.- Where a substantial cost benefit or improved performance may result from the use of circuits, materials, parts, processes, and construction other than those specified herein, the contractor shall request approval for their use from the contracting officer.

3.12.2 Design proposal.- As may be provided in the contract schedule, the contractor shall submit a preliminary design including an electron device complement report to the contracting officer for review and approval. The preliminary design shall include drawings showing the configuration of all chassis, panels, and circuit boards, with parts layouts and schematic diagrams. The electron device complement report shall include data on all semiconductor diodes, transistors, and integrated circuits to be used in the equipment, with full operating data at 0°C., at 25°C, and at 50°C.

3.12.3 Tests.- All tests required by Section 4 of this specification shall apply to the prototype equipment. The equipment may be delivered on the contract schedule after it has been reworked to new conditions prior to acceptance.

3.13 Optional: Power Supply 24V DC.

3.13.1 Construction.- The power supplies shall be of modular construction in metal cases. Three (3) modular power supplies shall be mounted in one assembly. The assembly, containing the 3 power supply modules, shall be capable of mounting in a standard 19 inch equipment rack. The mounting assembly shall not exceed a size E rack panel space and shall not be more than 14 inches in depth. Any number of power supplies shall be capable of operating in a parallel configuration. Each power supply module shall have an output terminal that will facilitate parallel connections. Terminations shall be made to barrier terminal strip/s mounted on the rear of the module. The terminations shall be provided with insulating cover/s. Any power supply module shall be capable of being physically removed from the mounting assembly without disturbing the operation of the remaining power supply modules. The contractor shall furnish two (2) handles which shall be mounted in a vertical position, one on each side of the front panel of the power supply panel assembly, and each handle shall be a minimum of 4 inches long.

3.13.1.1 Power output.- The power output shall be 24V DC at 5 AMP.

3.13.2 Regulation.- Regulation of any combination of modules operating in parallel shall not exceed the following limits when tested as a system or individually operated.

3.13.2.1 Load regulation.- With an input line variation from 105V to 130V AC the DC output shall vary not more than 0.05 percent and with a load change of one ampere to full load the regulation shall not vary more than 0.2 percent. The ripple shall not exceed 1 millivolt RMS with various input line voltage and changing load conditions the temperature coefficient shall not exceed 0.01%/°C.

3.13.3 Regulation response.- The regulation response shall be 100 microseconds or less to within 60 millivolts of nominal value from no load to full load and shall be 10 milliseconds or less to within 60 millivolts of nominal value from full load to no load.

3.13.4 Voltage adjustment.- The output voltage shall have a control for varying the output voltage a minimum of ±1 V with 1 millivolt resolution.

3.13.5 Overload protection.- The output of each power supply module shall be protected by a solid-state current limiting, adjustable overload control. Upon removal of an overload the voltage and current shall return to preset levels.

3.13.6 Overvoltage protection.- Each power supply module shall have an adjustable overvoltage crowbar protection device (spike suppressor).

3.13.6.1 Module failure.- Upon failure of any individual module or modules for any cause, the failed module will be removed from the load automatically. A failed module will not cause an interruption of the DC output current or voltages of the system.

3.13.7 Individual module requirements.

3.13.7.1 AC input.- The equipment shall meet all the following requirements when operated on inputs from 105 to 130V AC 50/60 Hertz single phase.

3.13.7.2 DC output.- See 3.13.1.1 and the contract for the option requirement.

3.13.7.3 DC output adjustment.- The DC output voltage shall be adjustable (see 3.13.4).

3.13.7.4 Ripple.- The ripple shall be less than 1 millivolt RMS.

3.13.7.5 Failure detector.- A built in failure detector circuit shall be provided in each module to monitor the output voltage. A module failure shall close a circuit terminated on the module terminal strip. Closure of the circuit of the detector will activate an external alarm devise (not a part of this specification) such as a light or buzzer.

3.13.8 AC line controls.- The AC line controls shall be mounted on the rear of the power supply module modifies (FAA-G-2100/1 Paragraph 1-3.6.5. The indicator light is not required. An indicating type AC fuse is required. A detachable AC line cord shall be provided in accordance with Paragraph 1-3.6.6.

## 4. QUALITY ASSURANCE PROVISIONS

4.1 General.- The contractor shall provide and maintain a quality control program which fulfills the requirements of FAA-STD-013, Inspection Systems Requirements. The contractor's quality program shall be a scheduled and disciplined plan of events integrating all necessary inspections and tests required to substantiate product quality during design, development, purchasing, subcontracting, manufacture, fabrication, processes, assembly, acceptance, packaging, and shipping. The contractor shall perform or have performed the inspections and tests required to substantiate product configuration and conformance to drawings, specifications, and contract requirements and shall also perform or have performed all inspections and tests otherwise required by the contract. The contractor shall provide and maintain measuring and testing devices in accordance with Paragraph 1-4.4 (and subparagraphs) of FAA-G-2100/1. See Section 1-4 of FAA-G-2100/1 for classification of tests and general methods of sampling and inspection.

4.2 Design qualification tests.- All design qualification tests including the "Systems" tests shall be performed on the first units prior to shipment on the first quantity due delivery schedule contract date.

4.2.1 Service conditions.- The following design qualification tests shall be made while subjecting the equipment to the test procedure prescribed under 1-4.12 of FAA-G-2100/1. The first regular audio and selector production units, consisting of an audio enclosure complete with each of the three plug-in modules, three selector enclosures complete with eight selector units per enclosure, a jack unit and an optional power supply shall receive the tests. Each of the following tests shall be conducted at 22.5, 24.0 and 26.0V DC power inputs.

| Test | Paragraph |
|---|---|
| a. Loudspeaker volume control | 3.3.1.1 |
| b. Headset volume control | 3.3.1.2 |
| c. Lamp brightness control | 3.3.1.3 |
| d. Transmitter selector switch | 3.3.2.1.1, 3.3.3 |
| e. Channel frequency designations | 3.3.2.1.4, 3.3.3 |
| f. Volume control | 3.3.3.2 |
| g. Telephone system connector | 3.4.1.3, 3.6.2.4 |
| h. Jack unit circuit | 3.6.2.1.1 |
| i. Switching time | 3.6.3.2 |
| j. Transmitter keying contacts | 3.6.3.3 |
| k. Thermal design (test at 26.0V DC only) | 4.5 |
| l. Power supply 24V DC (optional) | 3.13.4, 3.13.1, 3.13.2.1, 3.13.3, 3.13.5, 3.13.2, 3.13.6, 3.13.6.1, 3.13.7.4, 3.13.7.5 |

4.2.2 Normal test conditions.- The following design qualification tests shall be made under normal test conditions.

| | Test | Paragraph |
|---|---|---|
| a. | Input impedance | 3.6.2.2, 3.6.2.2.2 |
| b. | Output level control | 3.6.2.3 |
| c. | Output impedance | 3.6.2.6 |
| d. | Regulator attack time | 3.6.2.8, 3.6.4.5.2 |
| e. | Regulator release time | 3.6.2.9, 3.6.4.5.3 |
| f. | Input impedance | 3.6.4.2 |
| g. | Output impedance | 3.6.5.3 |
| h. | Input impedance | 3.6.5.4 |
| i. | Interchangeability | 3.4.6 |
| j. | Systems (12 positions and 24 radio channels) | 3.6, 3.6.1, 3.6.1.2, 3.6.1.3, 3.6.1.4, 3.6.1.5, 3.6.2, 3.6.2.1, 3.6.2.1.1, 3.6.2.2, 3.6.2.2.2, 3.6.2.3, 3.6.2.4, 3.6.2.11, 3.6.2.12, 3.6.3, 3.6.3.1, 3.6.3.4, 3.6.4, 3.6.4.3, 3.6.4.8, 3.6.7 |
| k. | Power supply 24V DC (optional) | 3.13.4 |

4.3 Type tests.

4.3.1 Service conditions.- The following type tests shall be made while subjecting the equipment, as listed in 4.2.1, to the test procedure described under 1-4.12 of FAA-G-2100/1. Each of the following tests shall be conducted at either 22.5, 24.0 or 26.0 V DC. The voltage selected for each series of tests shall be at the discretion of the FAA representative.

| | Test | Paragraph |
|---|---|---|
| a. | Frequency response | 3.6.1.1 |
| b. | Harmonic distortion | 3.6.1.2 |
| c. | Hum distortion | 3.6.1.3 |
| d. | Noise | 3.6.1.4 |
| e. | Power consumption | 3.6.1.5 |
| f. | Transmitter channel loading | 3.6.2.11 |
| g. | Transmitter channel crosstalk | 3.6.2.12 |
| h. | Push-to-talk switch current | 3.6.3.1 |
| i. | Receiver channel loading | 3.6.4.7 |
| j. | Receiver channel crosstalk | 3.6.4.8 |
| k. | Loudspeaker-headset crosstalk | 3.6.4.9 |
| l. | Isolation | 3.6.5.2 |
| m. | Power supply 24V DC (optional) | 3.13.1, 3.13.2, 3.13.2.1, 3.13.3, 3.13.4, 3.13.5, 3.13.6, 3.13.6.1, 3.13.7.4, 3.13.7.5 |

4.4 Production tests.

4.4.1 Normal test conditions.- The following production tests shall be performed on each unit while it is subjected to normal test conditions.

| | Test | Paragraph |
|---|---|---|
| a. | Transmit lamp | 3.3.2.1.2, 3.3.3 |
| b. | Receiver syllabic lamp | 3.3.2.1.3, 3.3.3 |
| c. | Receiver selector switch | 3.3.2.2, 3.3.3 |
| d. | Mute level switch | 3.3.3.1 |
| e. | Mute level adjust | 3.3.3.1.1 |
| f. | Receiver audio circuits | 3.3.3.1.2 |
| g. | Mute circuit insertion loss | 3.3.3.1.3 |
| h. | Mute lamp | 3.3.3.1.4 |
| i. | Output level | 3.6.2.4 |
| j. | Regulating range | 3.6.2.7, 3.6.4.5.1 |
| k. | Sidetone circuit | 3.6.2.10 |
| l. | Transmitter keying circuit | 3.6.3 |
| m. | Interlock | 3.6.3.4 |
| n. | Receiver syllabic lamp | 3.6.4.3 |
| o. | Receiver audio muting | 3.6.4.4 |
| p. | Headset amplifier | 3.6.4.5 |
| q. | Loudspeaker amplifier | 3.6.4.6 |
| r. | Input-output levels | 3.6.5.1 |
| s. | Recorder monitor lamp circuit | 3.6.6 |
| t. | Busy-tone circuit | 3.6.7 |
| u. | Regulator control range | 3.6.2.7.1 |
| v. | Power supply 24V DC (optional) | 3.13.1, 3.13.2.1, 3.13.3, 3.13.4, 3.13.5, 3.13.7.5 |

4.5 Thermal design tests.- The principles of thermal design as outlined in Section 6.1.3.2 of MIL-HDBK-217A shall be utilized in the design of the equipment. The contractor shall perform a thermal design test on one audio unit and one selector unit to verify that the part temperature data used for the reliability prediction is accurate. This test shall be conducted in an environment of 40°C and 80 percent relative humidity.

4.6 Integrated circuit quality assurance.- If integrated circuits are used in the equipment specified herein, they shall be subjected to the quality assurance tests in Paragraphs 4.6.1 and 4.6.2. When testing on a lot sample basis is specified a failure in the sample shall cause either rejection or 100 percent testing of the lot. Failure rate data shall be submitted to the FAA Contracting Officer for use in assessing equipment reliability. If the contractor so desires, he may submit, in lieu of the tests in 4.6.1 and 4.6.2, certified data and a statement from the integrated circuit manufacturer that the IC meets or exceeds the requirements of the tests.

4.6.1 Forty-eight hour static burn-in-test.- A 20 to 30 percent lot sample of each linear circuit type to be used in the production equipment shall be given a static burn-in-test prior to assembly in the equipment. The test shall be conducted at an ambient temperature of +50°C and a relative humidity of 90 percent. For the duration of the static test, each linear circuit shall dissipate the maximum power specified by the integrated circuit (IC) manufacturer. Digital circuits to be used in the equipment shall be static

tested under the same environment and power conditions; however, testing on a 10 to 15 percent lot sample basis shall be sufficient.

4.6.2 Hermetic seal test.- All flat package ICs shall be subjected to a gross leak and fine leak test after being temperature-cycled from 0°C to +50°C. The leak tests shall be conducted at room temperature. The TO-5 type package shall be tested under the same conditions but on a 10 percent to 15 percent lot sample basis.

4.7 Optional test equipment.- Each piece of optional test equipment shall be tested with pretested and accepted modules in place and shall be subjected to tests as listed in the following subparagraphs. These tests are to be performed during design qualification tests.

4.7.1 Design qualification tests, normal tests conditions.

| Test | Paragraph |
|---|---|
| a. Interchangeability | 3.4.6 |

4.7.2 Production tests, normal test conditions

All tests under this subparagraph shall be performed.

## 5. PREPARATION FOR DELIVERY

5.1 See MIL-E-17555.

## 6. NOTES

6.1 Outline design.- Figures 1, 2, and 3 are outline drawings of a typical assembly but are not requirements of this specification. These drawings are furnished only as a matter of information to the contractor, to assist him in visualizing a typical design. The Government does not represent or guarantee that conformance thereto will insure that the resulting product will meet specification requirements. Any reliance which the contractor places on Figures 1, 2, and 3 is wholly at his own risk and shall not relieve him of his contractual obligations to comply with all of the requirements of this specification.

6.2 Test equipment.- If optional test equipment is not required, the contract schedule should delete Paragraphs 3.8.2 and 4.7.

6.3 Optional power supply.- If the optional power supply is not required, the contract schedule should delete all paragraphs of section 3.13.

* * * * *

TABLE OF CONTENTS

TABLE OF CONTENTS (con'd)

TABLE OF CONTENTS (con'd)

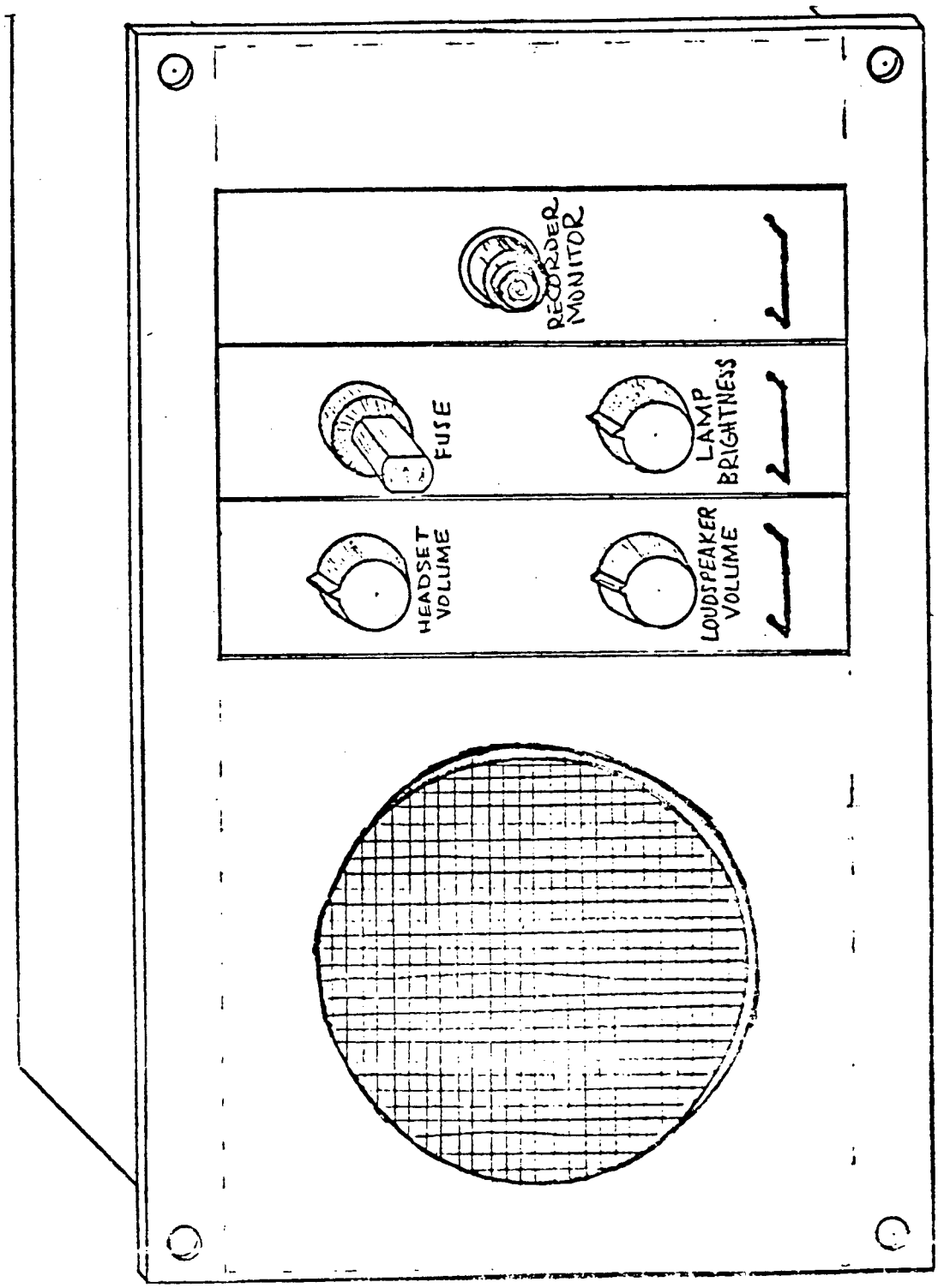


FIGURE 1 AUDIO UNIT - FRONT PANEL

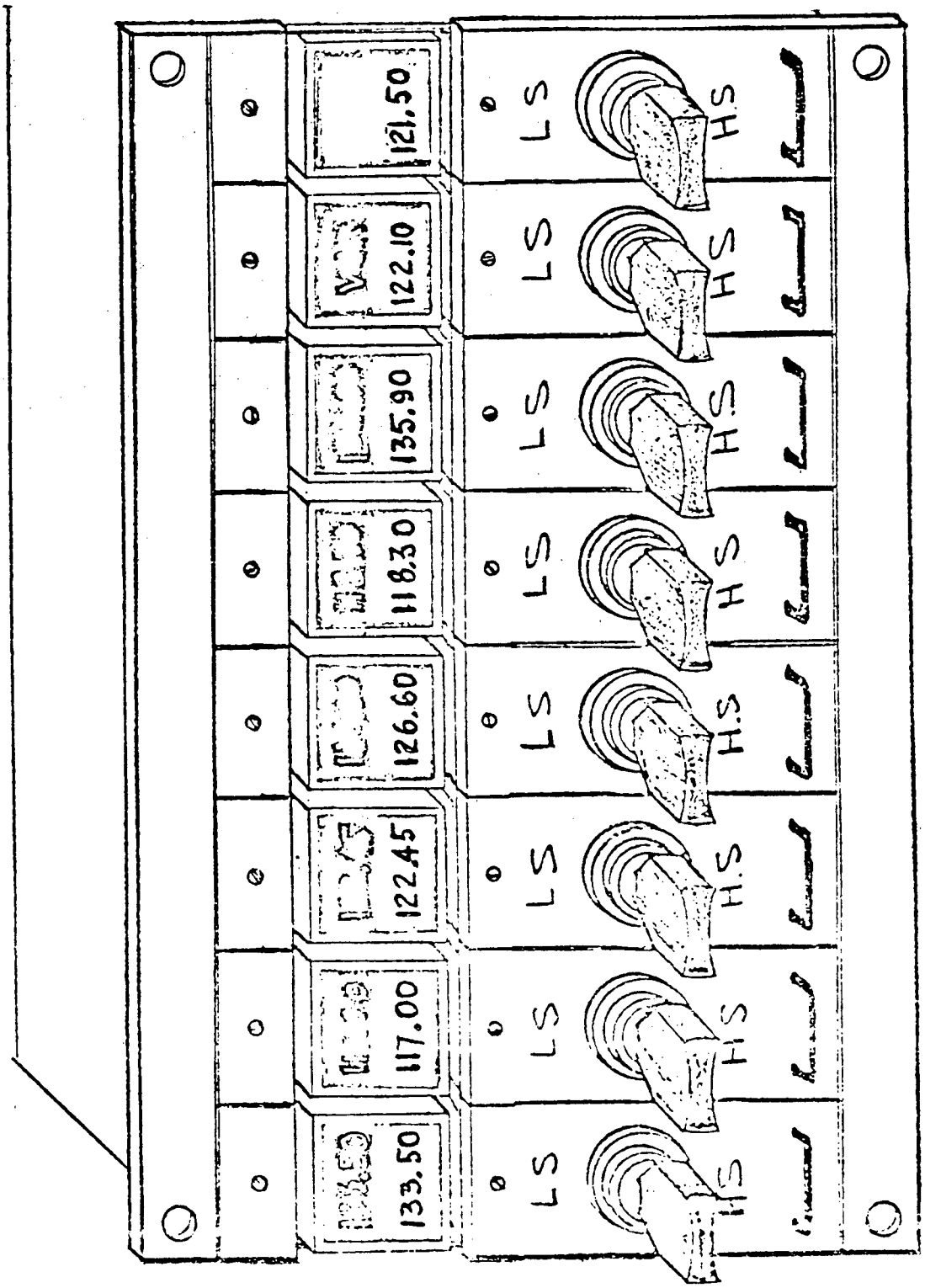


FIGURE 2 SELECTOR UNIT - FRONT PANEL

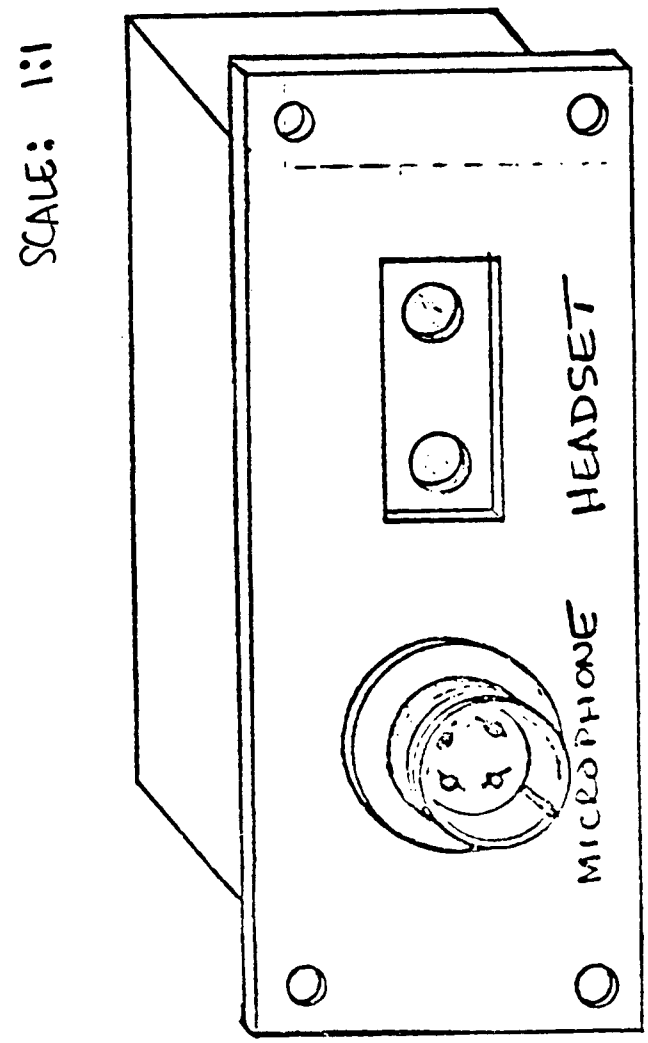


FIGURE 3 JACK UNIT - FRONT PANEL